CLAIMS

I claim:

1.   A transmitter operating in a switching-mode, the transmitter comprising:

a signal decomposition unit decomposing a modulated digital signal

into a first signal and a second signal, both being expressed in

polar coordinates mathematically;

an adaptive predistorter distorting the first and second signals

respectively in accordance with one or more of distorting

parameters;

a phase equalizer equalizing a time delay between the first and second

signals in response to a measurement provided by a feedback loop

operating on a sample of a RF signal from the transmitter; and

a power amplifier, controlled by the first signal and a phase-modulated

signal coupled from a voltage controlled oscillator, producing the

RF signal.

2.   The transmitter of claim 1, wherein the modulated digital signal is provided
from a baseband processor, the first signal is an amplitude signal, and the
second signal is a phase signal, and the phase-modulated signal is produced
from the second signal.

3.   The transmitter of claim 2, wherein the feedback loop includes a down-
converter, a demodulation unit and a measurement unit, and provides feedback
signals to at least the phase equalizer.

4.   The transmitter of claim 3, wherein the down-converter converts the sample to a lower frequency to be demodulated in the demodulation unit, and the demodulated sample is measured in the measurement unit for producing the feedback signals.

5.   The transmitter of claim 1, wherein the first signal is provided to indirectly control the power amplifier.

6.   The transmitter of claim 5, wherein the first signal activates a control unit to generate a bias control signal and a voltage signal in response to the first signal.

7.   The transmitter of claim 5, further comprising a first modulation path and a second modulation path, both operating on the second signal.

8.   The transmitter of claim 7, wherein the first modulation path provides a first input signal to the voltage controlled oscillator in response to the second signal processed in a phase gain unit.

9.   The transmitter of claim 8, wherein the second signal, after processed in the phase gain unit, is converted to an analog signal.

10.   The transmitter of claim 7, wherein the second modulation path provides a second input signal to the voltage controlled oscillator in response to the second signal processed in a phase offset unit.

11. The transmitter of claim 10, wherein the second modulation path is formed by a phase-locked loop (PLL) including an adder that couples both the first and second input signals to modulate the voltage controlled oscillator.

12. A method for controlling a transmitter to operate in a switching-mode, the method comprising:

decomposing a modulated digital signal into a first signal and a second signal, both being expressed in polar coordinates mathematically;

distorting the first and second signals respectively in accordance with one or more of distorting parameters;

equalizing a time delay between the first and second signals in response to a measurement provided by a feedback loop operating on a sample of a RF signal from the transmitter; and

producing the RF signal in a power amplifier controlled by the first signal and a control signal coupled from a voltage controlled oscillator.

13. The method of claim 12, wherein the modulated digital signal is provided from a baseband processor, the first signal is an amplitude signal, and the second signal is a phase signal, and the control signal is produced from the second signal.

14. The method of claim 12, wherein the feedback loop includes a down-converter, a demodulation unit and a measurement unit, and provides feedback signals to at least the phase equalizer.

15. The method of claim 14, wherein the down-converter converts the sample to a lower frequency to be demodulated in the demodulation unit, and the

demodulated sample is measured in the measurement unit for producing the feedback signals.

16.   The method of claim 12, wherein the first signal is provided to indirectly control the power amplifier.

17.   The method of claim 16, wherein the first signal activates a control unit to generate a bias control signal and a voltage signal in response to the first signal.

18.   The method of claim 16, further comprising a first modulation path and a second modulation path, both operating on the second signal.

19.   The method of claim 18, wherein the first modulation path provides a first input signal to the voltage controlled oscillator in response to the second signal processed in a phase gain unit.

20.   The method of claim 19, wherein the second signal, after processed in the phase gain unit, is converted to an analog signal.

21.   The method of claim 18, wherein the second modulation path provides a second input signal to the voltage controlled oscillator in response to the second signal processed in a phase offset unit.

22.   The method of claim 21, wherein the second modulation path is formed by a phase-locked loop (PLL) including an adder that couples both the first and second input signals to modulate the voltage controlled oscillator.

23.   A method for controlling a transmitter to operate in a switching-mode, the method comprising:

compensating frequency drift and other non-linear effects of a modulated voltage-controlled-oscillator (VCO) and a power amplifier by predistorting a baseband amplitude signal and a phase signal in accordance with one or more distorting parameters;

providing a phase-locked loop (PLL) with an adaptive phase gain and a phase offset control in response to the phase signal; and

modulating the power amplifier with the baseband amplitude signal and an output coupled from the modulated voltage controlled oscillator (VCO).

24.   The method of claim 23, further comprising:

demodulating samples of an output of the power amplifier and the modulated voltage controlled oscillator to regenerate a first signal, a second signal and a third signal in a digital format;

comparing the demodulated first and second signals to the baseband amplitude signal and phase signals with reference to the third signal, respectively; and

producing feedback control signals to update the one or more distorting parameters, and other related parameters.

25.   The method of claim 24, still further comprising equalizing a delay time between the baseband amplitude and phase signals.

26.   The method of claim 25, wherein the delay time is provided by one of the feedback control signals.

27. The method of claim 23, wherein the phase-locked loop (PLL) comprises:

the voltage-controlled oscillator (VCO) with a control input and a phase-modulated output;

a phase detector to compare two phase-modulated signals and produce an output representing the phase difference of the two phase-modulated signals;

a loop filter coupled to the output of the phase detector and to the input of the VCO;

a feedback loop including a feedback frequency divider which is coupled to the output of the VCO and to an input of the phase detector;

a reference frequency signal coupled to another input of the phase detector; and

a controller receiving a phase-modulated baseband signal and a carrier frequency signal to produce a digital bit stream used to control a divisor of the feedback frequency divider.

28. The method of claim 23, wherein a controller in the phase-locked loop (PLL) receives a phase-modulated baseband signal and a carrier frequency signal to produce a digital bit stream used to control a reference frequency coupled to an input of the phase detector.

29. The method of claim 23, wherein the VCO operates by:

adding the phase-modulated baseband signal to an input node of the VCO which is used by the phase-locked loop;

using an adaptive phase gain to scale the phase-modulated baseband signal which is directly added to the input node of the VCO of the phase-locked loop;

using an adaptive phase offset to change the phase-modulated baseband

signal which is applied to the input of the controller of a phase locked

loop; and

using adaptive digital predistortion to generate the adaptive phase gain

and phase offset signals.